DYSPHASIA:
MUSICAL PERCEPTION AS A STIMULUS IN COMMUNICATION

By
LIBBY RADUS

A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL OF
THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA
August, 1965

ACKNOWLEDGMENTS

The author expresses her sincere appreciation to Dr. McKenzie W. Buck, Chairman of her Supervisory Committee, for his guidance and assistance throughout the development of this dissertation. She also thanks Dr. G. Paul Moore, Chairman of the Department of Speech, for his constant willingness to assist, and the other members of the committee, each of whom has aided and counseled her in her endeavors. Special recognition is extended to Dr. Thomas B. Abbott, whose comments and suggestions during the writing of the dissertation were of inestimable value.

Acknowledgment and appreciation are extended to the Speech and Hearing Clinic of Greater St. Petersburg, the Easter Seal Rehabilitation Center in Tallahassee, the Speech and Hearing Clinic of Florida State University, the Audiology and Speech Clinic of the Outpatient Clinic at Jackson Memorial Hospital of the University of Miami, the Speech and Hearing Clinic at the University of Miami, the Broward County Society for Crippled Children and Adults in Fort Lauderdale, and the Rehabilitation Center for Crippled Children and Adults in Miami, and to the patients who lent themselves so willingly as subjects, and without whose cooperation this study could not have been completed.

Finally, the author is especially grateful to the members of her family, colleagues, and friends for their encouragement and unfailing support throughout her work on the doctoral program.

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CHAPTER I

INTRODUCTION AND PURPOSE

Rehabilitation of the communicative function in adults with dysphasia has at times imposed seemingly insurmountable obstacles on both the patient and clinician. The results of intensive training have frequently been meager, frustrating, and discouraging for the patients and professional personnel.

Modern medical advances have been such that the lives of a greater portion of our population are being prolonged. Linden points out that ". . . approximately 17,500,000 people in our country are age 65 or over. This group makes up over nine per cent of our nation's population." (20) However, as Peterson and Peterson have noted, improved medical care ". . . prevents death but leaves the survivors with severe disabilities." (30) These disabilities include a proportionate incidence of aphasia with its characteristic speech pathology.

For this reason there has ensued an increasing awareness and intensive exploration of this problem, resulting in the development of specific techniques which have been found to have some degree of efficacy. These efforts have included the works of Bordeaux, Decker, Granich, Huber, Schuell, Taylor, Wepman, and others in the field of speech pathology. There remain, however, language impaired individuals who achieve little success in rehabilitation. Therefore, it appears practicable to investigate previously explored as well as unexplored avenues. One of these avenues involves the factors of perception and discrimination of sound.

In an examination of the literature the multiplicity of factors which comprise the aphasic disturbance was found to be emphasized repeatedly. In 1955, Brain pointed out that aphasia is a confusing subject in that: ". . . it expands into the fields of linguistics, phonetics, and communication theory . . . partly because of its great complexity, . . . because of the conflicting interpretations which have been placed upon the facts." (3) In a later report he stressed both similarities and differences between speech and music. He reported:

> In its simplest form it (music) resembles speech in employing some or all of the muscles of articulation, ... Musical sounds, however, are not, like the sounds of speech, symbols. . . . Music may be linked with speech as in a song, . . . (4)

Other writers, among them Agronowitz and McKeown (1), Backus (2), Granich (14), Longerich (21), Longerich and Bordeaux (22), Martin (24), and Wepman (42) have indicated that for some patients, at one time or another, singing serves as a successful starting point in speech production. Several of these investigators have suggested that the rhythmic component of songs may be more effectively utilized by beating out the rhythm to fix the contour pattern of the sounds.

Speech disorders and auditory and musical abilities

The involvement of auditory perception in speech was considered as long ago as the 1920's. Travis and Davis (41) and Stinchfield (39) studied the relationship between speech defects and ability to discriminate pitch, intensity, and tonal memory. The former reported that these three senses entered into the speech function in special corrective speech groups, i.e., for individuals with speech defects of a non-organic nature.

In regard to the factor of pitch, Galambos (11) expressed the feeling that a combination of an inborn ability to discern and analyze differences between tonal frequencies, and the skill acquired in developing this ability, results in man's pitch experience. A neurological basis is present for this achievement but it is not necessarily used and cultivated to an equal degree in all individuals.

Pursuing the neurological concept, Cohen and Diehl (6) stated that one could not be certain of the exact neurological link which may exist between discrimination on the one hand and the accurate production of speech sounds on the other. The formulation of hypotheses, based on a better understanding of the relationships between discrimination and articulation, may provide a basis for a better knowledge of both areas. They suggested that what is needed, and would be of value, are additional objective data on the affinity between articulation defects and standardized discrimination tasks.

The preceding review appears to point to the significance of the discrimination factor. Additional support is provided by Eisenson, Kastein, and Schneiderman who stated:

> That aspect of hearing which has to do with discrimination among various types of sounds has been studied with regard to the discovery of methods and norms for measuring such

> discrimination and its relation to musical talent. Some investigators have studied the relationship of discrimination abilities to different aspects of speech skill, but the body of evidence in this area remains very limited. (9)

The same authors reported on Horowitz's unpublished study completed in 1949, in which the latter attempted:

> . . . to correlate ability as shown by the Seashore measures for pitch, intensity (loudness), and rhythm with the effectiveness of speaking as rated by judges. Her subjects were normal speakers. She found a slight relationship between speech skill and the scores for rhythm and pitch discrimination, . . .

An investigation by Kronvall and Diehl (17) concluded that within the limitations of their study a significantly greater number of errors in speech sound discrimination was made by children with severe functional articulatory disorders in the elementary grades, than by a matched group of normally speaking children.

Later studies by Mange (23), Schiefulbusch and Lindsey (33), and Sommers, Meyer, and Fenton (38), also pointed up relationships between selected auditory perceptual factors, such as discrimination of pitch, loudness, and quality (timbre). Mange has postulated the following:

> In cases of auditory deficiency, defective articulation may arise either from a defective model which guides the output or from a failure of the mechanism which compares the output with the intended or desired production. . . . it would be reasonable to assume that the defect originally arose from a failure of the comparative mechanism from which the original auditory image or model had to be derived. Substandard function of some component of the speech servomechanism would then appear to be a possible cause of many functional articulatory disorders. (23)

Proceeding along similar lines, Schuell (34), in reporting on a group of 15 patients in a Veterans Administration Hospital, discussed the concept of "reauditorization," the retention and recall of sound patterns utilized in language. She observed that the patients' reduced ability to say things back to themselves was one of their chief difficulties. According to Schuell, this is one of the ways impairment of reauditorization would be expected to operate, that is, the patients would not recall sound sequences correctly; thus mispronunciations would be predictable because reauditorization would be imperfect. However, such errors were different from those made by dysarthric patients. Hence, one of the prime factors in word finding difficulties may be this reduced ability to summon, at will, a desired sound sequence, although this is probably only one of the factors involved. She expressed agreement with others, previously quoted, in stating that aphasic disorders are complex but that diagnosis of the source of the difficulty must precede effective therapy.

Schuell (35) further emphasized this point to the effect that a correlation exists between the type of impairment which affects comprehension of the spoken language and the progress achieved through therapy. This interrelation depends more upon the specific nature of the existent receptive difficulty than upon the degree of impairment. Investigation of the patients' language disabilities points towards the previously mentioned reduction of the ability to summon forth or recall sound sequences, as they are used in language, as the basis of the difficulty. It is this condition that is tentatively thought of as impairment of reauditorization and as possibly being reversible to a considerable degree.

Analagous to Schuell's concept is Wepman's (43) discussion of the aphasic's difficulty in recognizing and being capable of correcting his errors in speaking. Wepman suggested eight levels of self-correction and proposed that a better indicator of the patient's prognosis is the rapidity with which he moves from one stage of self-correction to another, rather than the degree of severity of the aphasic disorder.

The importance of correct classification of auditory impairment was investigated by both Street and Miller. The latter stated:

> Aphasic patients manifest disturbances in their ability to recognize, retain, and recall sound patterns. . . . It is necessary to differentiate disturbances in auditory perception from an actual reduction in hearing sensitivity due to peripheral or central lesions. (27)

In addition, Street pointed out:

> Aphasic patients commonly experience difficulty in understanding spoken language. This difficulty may be largely the result of impairment of auditory perception, recognition, or retention span. (40)

This specific aspect of hearing has also been stressed in the frequently quoted study by Winchester and Hartman in which the authors state:

> . . . hearing constitutes one of the most basic and important of the sensory modalities through which relationships with the environment are established, and a disturbance of the listening function (although no significant lessening of auditory acuity be present) might well influence the fundamental adjustment patterns of the dysphasic persons and lead to special problems with reference to his speech and language rehabilitation. (45)

The above authors reported on a study, by Werner and Bowers (1941), which investigated auditory perception by means of tests calling for the reproduction of simple patterns of melody. Results of this study concluded that when the brain-injured child was compared with the normal child, the former presented a picture of deficient, erratic test behavior which, in Winchester and Hartman's opinion, indicated decreased capability of grasping the essential melodic whole. Diagnosis of central neurological lesions with their accompanying linguistic disorders, and prognosis, might be inferred from this manifestation of auditory differentiation.

Speech disorders and linguistic abilities

Roberts (31) alluded to the science of language (linguistics) as the system of speech sounds by which communication between human beings takes place. As the linguist continued to learn more about language, the speech pathologist learned from the linguist about the processes of language development and its breakdown. In general, people have been automatically manipulating the complicated structure of the English language all their lives; it is not necessary for them to stop and reflect on its sound structure or grammar. It has been found that even a three-year-old child can respond accurately to those signals which serve to distinguish one kind of English sentence from another. This occurs despite the fact that the English language has 24 consonant phonemes (groupings of similar sounds), and nine vowel phonemes, in addition to 12 intonation phonemes. In addition, there are 27 possible diphthongs.

Roberts also mentioned that the contrasting of patterns exerts an important influence on how speech is comprehended. Meaning is conveyed through these patterns and it is important to hear the difference in two things that are actually very close to one another. Native speakers of a language are conditioned to pick up the most minute contrast. He emphasized that "It is the contrast between phonemes which distinguishes between different words." (31)

Another conception of linguistics is described by Osgood and Miron (29) as those regularities or rules within a language which allow the speaker of that language to produce all its correct utterances. Two levels of language organization are dealt with in linguistic analysis: the sound system (phonetics and phonemics) and the grammar (morphemics and syntax).

In 1956, Jakobson, an outstanding scholar in the field of linguistics, emphasized that "Linguistics is concerned with language in all its aspects--language in operation, language in drift, language in the nascent state, and language in dissolution." (16) He continued by referring to the high importance which had been assigned by psychopathologists to the linguistic problems implicit in language disturbances. However, despite the fact that consideration had been given to these questions in some of the more recent and better treatises on aphasia, in most cases the justifiable concern with the linguist's contribution to the investigation of aphasia had been almost persistently ignored.

In 1961, Brain contributed to the description of linguistics by representing it as: ". . . the most recent field of work in aphasia, which it seeks to illuminate by studying the changes in the vocabulary of the aphasic patient, . . ." (4)

Regarding the phonemic aspect of language, and in partial support of its important role, it has been observed that semantic differences result when stress patterns are changed within different phonemic contexts. Pitch, stress, and juncture make up intonation and, as pitch relates to juncture, semantic differences will be found. Impairment of the ability to discern these fine distinctions would bring with it an impairment in the "flow" of speech. Where juncture comes only at certain intervals, semantic difficulties would be created for the individual whose ability to be aware of the points of juncture is impaired. These factors relate to language in a very meaningful manner.

The area of semantics, according to Francis (10), refers to the study of meaning and rightfully belongs in the field of linguistics. Suprasegmental phonemes of stress and pitch which are superimposed on the basic phonemes must be taken into account. Although the stress may be minimal, it is present and is an essential part of the segment, as is true of pitch, which is an inescapable quality of sounds that have tone, as compared to those sounds that are merely noise.

Four degrees of stress are usually recognized in phonetics, stress being an inextricable feature of pitch. These four degrees are actually phonemes, whose allophones are the various minute gradations of stress perceptible in actual speech. An allophone is perceived as a different phonetype, a member of a phoneme, e.g., a different way of articulating an [l]. There are also four levels of pitch or pitch phonemes. Many changes of pitch influence meaning; even a slight change may be significant.

In addition, there are three significant types of joints or transitions between phonemes, one of which has three subtypes. These junctures, according to Francis, ". . . combine with pitch and stress patterns to make the complex prosodic patterns which are one of the most important features of the grammar of spoken English." (10)

The process of analysis is apparently so complicated that it is remarkable that man learns to speak or understand any language. For example, it is understood that recognition of parts of speech is a wholly unconscious procedure in ordinary listening or reading. But, without being conscious of this, the speaker who inadvertently uses an adverb where an adjective belongs is aware that he has made a mistake and may correct himself before he continues. This seemingly normal process in the non-aphasic individual may explain Wepman's concern with the aphasic's difficulty in self-correction and Schuell's concept of reauditorization, Hence, these factors obviously assume roles of significant proportions.

In reference to this complicated process, Francis stated:

> . . . words are combined with one another to make larger structures that convey more meaning than the mere aggregate of the independent meanings of the words themselves. . . . speakers use, along with the full or lexical words, other words that we call function words, as well as inflections, and that the order of arrangement and the prosodic factors of pitch, stress, and juncture are other important indicators of structural patterns. (10)

The viewpoints expressed in the review of the literature are borne out by Carhart et al. (5) In a monograph supplement which covered "Research Needs in Speech Pathology and Audiology," they mention, among other questions, two areas of research which appear to be pertinent to the present study. They are:

> 1. What are the varieties of experience that are encompassed in hearing? For example . . . what are the roles of loudness, pitch, discrimination of complex symbols, and other factors in auditory experience?
>
> 2. What is the relationship between measures of hearing function and the handicap an individual possesses?

Questions such as these appear to warrant further investigation of this relationship.

Purpose

The purpose of this study was to determine: (1) how adults who have language impairments due to brain damage, perceived musical stimuli, and (2) to what extent these abilities were related to communication abilities in the same group. The increasing recognition of the need for more definitive information and for improved diagnostic tools in order to assist the dysphasic patient to re-establish his impaired lines of communication, forms the basis for the study.

The two primary measures utilized in exploring the relationships between the ability to discriminate sound and the degree of severity of the aphasic disability were the Seashore Measures of Musical Talents and the Wepman-Jones Language Modalities Test. In addition, the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities was administered. These are to be discussed in detail in Chapter II. Specifically, answers to the following questions were sought:

1. What indications are there of relationships between the degree of ability to discriminate

"pitch," "loudness," "rhythm," "time," "timbre," and "tonal memory" and the severity of aphasic disability?

2. What indications are there of a relationship between the degree of ability to discriminate "pitch," "rhythm," "time," and "tonal memory" and achievement on the Auditory-Vocal Sequencing Test, i.e., retention of sound sequences?

CHAPTER II

DESCRIPTION OF PROCEDURE

In order to determine whether a relationship exists between the ability to perceive and discriminate between sound stimuli and the degree of severity of the aphasic disability, the following procedures were employed.

Selection of subjects

Fifteen Caucasian subjects, age range 40 to 65, with medical diagnoses of dysphasia, and no more than a moderate degree of dysarthria, were selected for this investigation. Etiology of the brain damage, educational level, pre-morbid occupation, and the time elapsed since onset of the trauma were not taken into consideration within the limitations of this study. Fifteen subjects were thought to be sufficient for this study since, as McNemar has pointed out:

> Some psychologists frown upon the use of small samples, as, for example, N less than 25; a few use such small samples, but scorn the necessity of evaluating their results in terms of the mathematics of small samples . . . while others will rightfully argue that when small samples, properly evaluated, yield a difference which would arise by chance only once in a hundred times, the result is just as dependable as if the same chance figure had been found for large samples. It is assumed in either case--small or large sampling--that the sampling technique is such as to avoid bias. It is commonly and erroneously thought that some magic lies in large samples, and that bias is less apt to be present. . . . the

> demonstration of a difference (or effect) which is large enough to possess any practical or social significance will not require large samples. (26)

These criteria were set forth in the sixteen letters (see Appendix A) sent to speech and hearing clinics, rehabilitation centers, and a university hospital outpatient clinic, all within the State of Florida. The letters stated the purpose of the study, the various measures to be utilized, and the criteria for selection of subjects. Fifteen replies were received; four out of this number provided affirmative answers which indicated that each had patients who met the criteria.

Criteria

In addition to color (Caucasian), age 40 to 65, and medical diagnosis of dysphasia, it was necessary that the subjects' hearing fall within normal limits, at least unilaterally. Further, the individual's intelligence level was to fall within the normal range.

The investigator traveled to St. Petersburg, Tallahassee, Fort Lauderdale, Miami, and Coral Gables. At these locations the required number of subjects was obtained following further screening and selection.

Screening procedure

In order to determine whether the criterion of adequate hearing was met, the first procedure was the administering of a pure tone audiometric threshold test. This was carried out in an acceptably quiet location within the individual centers. The testing encompassed the frequency range from 125 to 8,000 cps; an F-1

Maico portable audiometer, which had been properly calibrated and checked at each testing session with the investigator's own ear, was used consistently.

The level of intelligence was determined through utilization of the Peabody Picture Vocabulary test, Form A, (7) which presents pictorial representations of objects, events, and actions. Its upper applicable age level extends to 18 years.

Testing procedure

The tests were administered in consistent order for all subjects and a rest period was given at appropriate intervals to counteract the fatigue factor. Two separate sessions, on two successive days, were required for the completion of the test battery. The average time for the two sessions was four hours.

Seashore Measures of Musical Talents

Purpose. Within the framework of this study, the function of the Seashore Measures of Musical Talents was to evaluate the ability of the 15 aphasic subjects to perceive and discriminate differences in pairs of stimuli for six capacities: pitch, loudness, rhythm, time, timbre, and tonal memory. Four of the subtests contained 50 pairs of stimuli each; two contained 30 each, a total of 260 pairs of presentations.

Equipment and materials. The Measures were transposed from the phonograph records published by The Psychological Corporation to heavy duty Scotch brand recording tape, #175, and were presented to the subject on a Model T-1500 Wollensak tape recorder.

Procedure. The investigator had recognized, in agreement with

Edmondson's (8) findings in 1954, that some difficuly might be anticipated in conveying instructions to the subject, and, consequently, his execution of them. Therefore, verbal instructions were supplemented by gestures and pantomime, and ample practice was allowed to insure the subject's understanding of the tasks. Simple hand signals by the subject were agreed upon and the individual was permitted to take as much time as he seemed to need, within reasonable limits, to respond. The examiner recorded the subject's responses on the answer sheets especially designed for this purpose.

Rationale. According to Carl Seashore, the originator of the Seashore Measures of Musical Talents, they were planned to:

> . . . provide separate measures for six capacities: pitch, loudness, rhythm, time, timbre, and tonal memory. The six tests are administered separately and measure different aspects of musical ability. (36)

The purposes for devising these measures, as stated by Seashore, were: "(1) to measure native and basic capacities in musical talent . . ., and (2) to measure one specific capacity at a time; . . ." He explained the basic capacities as measuring ". . . receptivity for one of the four musical avenues, namely, the tonal, the dynamic, the temporal, and the qualitative." (36)

In addition, Seashore stated that:

> There are two measures which are basic to all dynamic aspects of tone, sensitivity and discrimination. The first is the measure of the natural capacity of the ear for becoming aware of sounds; the second is a measure of the capacity of the ear for hearing differences and, therefore, the power to use the ear in a musically significant way dynamically, that is, to assign musical meaning to loudness characteristics. (36)

Seashore referred to those differences as playing ". . . a very important role in determining success or failure in ordinary intercourse and in vocations which involve discriminative hearing, particularly in music and speech." (36) An analagous premise was that the talents his test measured performed a function in speech very much as they did in music.

In 1940, a study conducted by Saetveit, Lewis, and Seashore at the University of Iowa emphasized that:

> The inclusion of measures of capacity for discriminating pitch, loudness, duration, and timbre is readily justified because they yield information on the responsiveness of the individual to the four basic media of all music and speech. (32)

In a more recent study, Leutenegger (1963) stated that:

> The pitch, intensity, and time subtests measure basic properties of sound which underlie both speech and music. They measure aspects of audition which are probably as vital to speech and language proficiency as they are to musical ability. . . . However, even the aptitude measured by the tonal memory subtest--the problem of retaining and comparing sound sequences--is common to both music and speech or language. . . . the Seashore Measures can be a valid research tool despite the music connotation possible from the words "Musical Talents" in the test's title. Prior experiments . . . in speech give indication of the potential fruitfulness of continued research with the Seashore Measures. (19)

The Seashore Measures were also chosen by Milner, as recently as 1962, for her studies on "Laterality Effects in Audition" which formed ". . . part of a broader long-term investigation of learning and *perception* in human subjects undergoing unilateral temporal lobectomy. . . ." (28) (Italics inserted)

Other investigators who have made use of the Seashore Measures in their research in the areas of perception and discrimination were: Edmondson (8), Gilkinson (12), Hanley (15), and Lane and Moore (18).

The Seashore Measures of Musical Talents were standardized on a normal population, and cover age groups in Grades four through 16. Saetveit *et al.* reported that: "Although norms are presented only for various educational levels, the tests have been successfully used with adults." (37)

The Wepman-Jones Language Modalities Test for Aphasia

The manual which accompanies this test describes it as a balanced set of simple tasks, requiring five different types of responses, within the major sensory modalities of vision, audition, and the motor pathways of speech and writing. In the Tell-a-Story item, the responses are classified in the following six groups: normal, syntactic, semantic, pragmatic, jargon, and global aphasias. These delineate the type of aphasia and its severity, and each type, in order of increasing severity of the impairment, is represented by a numerical score ranging from one to six.

However, in other sets of stimuli which form a portion of the test, while the results are also categorized in six groups, these differ from the above in that the pragmatic classification is omitted here and a phonemic or orthographic classification is included under category two, thus changing the scoring from that in the Tell-a-Story. Still other sets are scored simply as plus or minus, rather than from one to six, *i.e.*, normal to most severe.

Purpose. The Modalities Test was the second test administered of the two primary tests used. It had been standardized on aphasic patients and, therefore, would demonstrate the dimensions of the subjects' disabilities.

Equipment and materials. The equipment used for this test was a portable film-strip viewer with a self-contained viewing screen. Materials consisted of a 35mm film strip (Form II) and two types of record booklets, one for the examiner and one for the subject. The responses were recorded by the former or the latter, according to instructions in the manual.

Rationale. In the manual describing this test, the authors wrote that:

> We conceive of language as consisting of three processes, each of which is believed to be acquired separately by the child and is sufficiently independent of the other two that it may be uniquely impaired:
>
> 1. recognizing and comprehending an incoming signal by associating it with previously acquired concepts
>
> 2. attaching a previously acquired verbal symbol to a concept
>
> 3. imbedding a verbal symbol into a previously acquired and relatively automatized grammatical matrix. (44)

The test was designed for research and clinical use and was originally constructed on the basis of extensive analysis of the execution of the various test features by over 200 adult aphasic patients. It yields a measure of the patients' ability to use syntax as well as vocabulary. A revised test was standardized on 50 "selected" aphasic patients in 1958-59. The authors maintain that,

". . . because of its standardization, it provides a research tool for both intra-individual changes and inter-individual comparisons." (44)

Illinois Test of Psycholinguistic Abilities--Auditory-Vocal Sequencing Test

Purpose. The authors' purpose for the Auditory-Vocal Sequencing Test was to assess the subject's efficiency in reproducing a sequence of auditory stimuli from memory. The test was included in this study to determine if any relations existed between the aphasic individual's performance ability on this test and his ability to discriminate on the "pitch," "rhythm," "time," and "tonal memory" subtests on the Seashore Measures. Each of these subtests on the Seashore involves retention of sound sequences, a capacity which is also involved in speech and language.

Material. An examiner's record form contained four groups of five sets of numbers each. The series started out with two groups of two numbers each, proceeded to four groups of three numbers each, and progressed through sets of four, five, six, and seven digits.

Procedure. In accordance with the instructions, the examiner voiced the digits at a uniform rate of two per second. The subject was to repeat these after the examiner. Two trials were given, the subject receiving two points for success on the first trial, one point for success on the second. Basal and ceiling levels were established; the score was the total number of points received.

Rationale. The Illinois Test of Psycholinguistic Abilities was originally devised:

> . . . to meet the need for a comprehensive instrument for the assessment of language development in exceptional children, particularly those of pre-school age. . . . It was decided to undertake the construction of a new test battery incorporating . . . changes, and to standardize it on a population of greater size and age range. . . . The present test battery was standardized on 700 children, ranging from two-and-a-half to nine years of age. (25)

The incorporation of the Auditory-Vocal Sequencing Test in the test battery, and investigation of comparisons of achievement on it with the results of the "pitch," "rhythm," "time," and "tonal memory" subtests on the Seashore Measures, may possibly reveal a relationship between the dysphasic's ability to discern differences between two sound stimuli or sequences of sound stimuli, and his ability to retain sound sequences of increasing magnitude. This relationship, in turn, could be indicative of one basis or source of impairment and might point to specific avenues to be employed in the therapeutic approach. In one sense, this is "diagnostic testing," which McCarthy and Kirk conceived of as one of the goals of the test. In support of this concept they stated that: "A diagnostic test, . . . will inevitably be a test battery made up of tests, each of which assesses some important aspect of a global area, such as linguistic ability." (25) It is this linguistic ability which, among others, appears to be impaired in the individual with dysphasia.

Interviewing procedure

Prior to the screening and test procedures, the purpose of the study was explained to each subject and, if accompanied by a spouse, to the latter as well. An interview, based on a case history questionnaire formulated by the examiner (see Appendix B), was conducted with the spouse and/or the subject himself, at an appropriate time. In addition, pertinent information was provided through perusal of clinical records.

Each individual involved was interviewed privately in a professional environment and assurance was given that no confidential information would be divulged to any persons not directly connected with the study, and that identities would not be revealed. This method appeared to establish a most favorable climate within which both the testing and interview procedures were carried out with a much greater degree of rapport than may otherwise have been possible.

The above described procedure was employed with each subject examined during this study.

CHAPTER III

RESULTS

The data on which the results of this study were based were secured by administering of the Seashore Measures of Musical Talents, the Wepman-Jones Language Modalities Test, and the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities. The procedures employed in administering these tests were fully discussed in Chapter II.

Background information

As mentioned in Chapter II, there were 15 subjects selected for the study. All subjects were members of the Caucasian race; the age range was 39-5 to 64-6; there were seven females and eight males. The investigator was cognizant of the following variables: time lapse since onset of trauma, length of period of language retraining, highest educational level attained, pre-morbid occupation, and some variation in shift of handedness. This information was obtained from clinical records, and from the interview with the subject and/or spouse, and is shown in Table 1.

Table 2 provides the results of the Peabody Picture Vocabulary Test, Form A, in I.Q. scores; Table 3 presents the

Table 1. Information on personal history derived from case history questionnaire.

Subject	C.A.	Sex	Time Lapse Since Trauma	Duration of Therapy
1	58-3	F	48 mos.	36 mos.
2	39-5	M	3/4 mo.	eval. only
3	43-4	F	17 mos.	none
4	44-6	F	41 mos.	24 mos.
5	64-6	M	18 mos.	4 mos.
6	42-1	M	20 mos.	12 mos.
7	58-2	M	24 mos.	24 mos.
8	39-6	F	84 mos.	84 mos.
9	62-10	F	23 mos.	7 mos.
10	61-5	M	13 mos.	5 mos.
11	56-3	F	24 mos.	9 mos.
12	43-6	F	77 mos.	8 mos.
13	49-10	M	24 mos.	10 mos.
14	52-7	M	95 mos.	6 mos.
15	56-5	M	14 mos.	9 mos.
Range	39-5 to 64-6	7F 8M	3/4 mo. to 95 mos.	0 to 84 mos.

Table 1. Continued

Shift in Handedness Following Trauma	Musical Background*	Formal Education (in grade)	Pre-morbid Occupation
. . . No	PI	12th grade	Housewife
. . . No	L	11th grade	Waiter
. . . Yes	PI	10th grade	Housewife
. . . Yes	L	12th grade	Housewife
. . . Yes	L	16th grade	Struct. Eng.
. . . Yes	PI	12th grade***	Chief Eng.
. . . Yes	L	12th grade	Tax Assessor
. . . Yes	L	14th grade	Reg. Nurse
. . . Yes	PS	12th grade	Housewife
. . . Yes	PI	12th grade***	Investments
. . . No	PS	12th grade***	Bank Teller
. . . Yes**	L	12th grade***	Accountant
. . . No	L	12th grade***	Supervisor
. . . Yes	L	8th grade	Taxi Driver
. . . Yes	L	14th grade	Insurance
Range		8th to 16th grade	

*PI - played an instrument
L - listened to music
S - sang

** - except for writing

*** - additional courses

Table 2. The chronological age (C.A.), mental age (M.A.), and intelligence quotient (I.Q.) for each subject on the Peabody Picture Vocabulary Test, Form A.

Subject	C.A.	M.A.	I.Q.
1	58-3	11-9	75
2	39-5	17-2	97
3	43-4	18	133
4	44-6	18	101
5	64-6	18	128
6	42-1	16-7	95
7	58-2	18	116
8	39-6	12-11	81
9	62-10	18	128
10	61-5	12-11	81
11	56-3	18	105
12	43-6	18	119
13	49-10	16-3	94
14	52-7	12-11	81
15	56-5	18	123

Range		
	C.A.	39-5 to 64-6
	M.A.	11-9 to 18
	I.Q.	75 to 133

Table 3. Pure tone audiometric test averages in the speech frequency range for 500 cps, 1,000 cps, and 2,000 cps (1951 ASA zero reference level).

Subject	Right Ear	Left Ear
1	15 db.	20 db.
2	8 db.	12 db.
3	12 db.	0 db.
4	10 db.	5 db.
5	15 db.	10 db.
6	15 db.	12 db.
7	12 db.	12 db.
8	5 db.	8 db.
9	8 db.	5 db.
10	12 db.	10 db.
11	12 db.	13 db.
12	15 db.	27 db.
13	12 db.	15 db.
14	8 db.	25 db.
15	37 db.	17 db.

results of the pure tone audiometric test in terms of the average range within the speech frequencies (500, 1,000, and 2,000 cps) for each ear, in ASA 1951 zero reference levels. These two tests determined that the subjects met the criteria for this study. For the Peabody Picture Vocabulary Test, basal and ceiling levels were established and the raw scores were converted to I.Q. scores, in accordance with instructions in the Test Manual (7).

Information concerning personal history, gleaned from the case history questionnaire and the clinical records, will be discussed in Chapter IV.

Statistical treatment

The statistical analysis of the data included the calculation of a set of correlation coefficients to measure the linear correlations between the following: each of the six subtests of the Seashore Measures of Musical Talents and each classification of the Wepman-Jones Language Modalities Test, i.e., visual, auditory, and Tell-a-Story (Free Response); and between the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities and the "pitch," "rhythm," "time," and "tonal memory" subtests of the Seashore Measures. In addition, certain nonparametric statistical methods, that is, the calculations of certain probabilities, were employed to emphasize interesting and significant trends that had been noticeable in the set of correlation coefficients which had been computed. This will be discussed in Chapter IV.

In order to utilize the data more effectively it was necessary to perform a number of preliminary steps. While it was possible to use the originally obtained raw scores on the Seashore Measures (see Table 4), it was found essential to convert the original raw scores on the Modalities Test in order to calculate the correlations. This was handled by, first, totaling the tallied responses for each of the six categories, for each modality; second, multiplying the total in each individual category by the numerical score assigned by Wepman-Jones to that category (one to six); third, transposing the total of the scores under the visual and auditory "plus" (or pass-fail) classification to the "normal" category (one). The total under the visual and auditory "minus" classification was then broken down and allocated to some one of the six categories, depending upon the nature of the response to the stimuli.

Both the visual and auditory modalities categories were labeled as follows: one - normal, two - phonemic or orthographic, three - syntactic, four - semantic, five - jargon, and six - global. In comparison, in the Tell-a-Story (Free Response), categories one to six were labeled: one - normal, two - syntactic, three - semantic, four - pragmatic, five - jargon, six - global. Thus, there would have been an inconsistency in the correlation of the visual and auditory modalities classifications had a conversion not been carried out. Hence, the scores under category two, which were originally labeled "syntactic" on the Tell-a-Story, were multiplied by three to equate them with the visual and auditory modalities;

Table 4. Raw scores (R.S.) and percentile equivalents (P.E.) of subjects' performance on the Seashore Measures of Musical Talents (in order presented) including means of norms.

	Pitch 50 Items		Loudness 50 Items		Rhythm 30 Items		Time 50 Items	
Subject*	R.S.	P.E.	R.S.	P.E.	R.S.	P.E.	R.S.	P.E.
1	28	6	27	1	18	1	43	71
2	22	1	35	7	16	1	37	24
3	35	20	31	2	24	19	34	12
4	40	40	34	5	17	1	31	5
5	35	20	38	15	23	12	44	79
6	36	23	29	1	22	8	40	45
7	24	2	31	2	21	5	19	1
8	33	15	40	24	19	2	46	92
9	25	3	22	1	15	1	23	1
10	30	9	30	2	21	5	46	92
11	39	35	42	39	25	28	40	45
12	18	1	33	3	15	1	35	15
13	28	6	37	11	23	12	32	7
14	8	1	22	1	24	19	27	2
15	26	4	41	30	20	3	40	45

*The ordering of the subjects is consistent in each table.

Range	8-40	1-40	22-42	1-39	15-25	1-28	19-46	1-92
Mean	28.46	12.4	32.8	9.6	20.2	7.86	35.8	35.7
Norms		40.4		42.8		26.5		40.3

Table 4. Continued

	Timbre 50 Items		Tonal Memory 30 Items		Raw Score Mean (43.3)	Percentile Equivalent Mean
	R.S.	P.E.	R.S.	P.E.		
. . .	27	2	16	6	26.5	14.5
. . .	38	45	14	3	27.0	13.5
. . .	30	6	25	43	29.8	17.0
. . .	33	15	24	35	29.8	16.8
. . .	27	2	18	10	30.8	23.0
. . .	30	6	22	24	29.8	17.8
. . .	24	1	16	6	22.5	19.5
. . .	29	4	14	3	30.1	23.3
. . .	24	1	5	1	19.0	1.3
. . .	29	4	17	8	28.8	20.0
. . .	21	1	17	8	30.6	26.0
. . .	31	8	12	1	24.0	4.8
. . .	39	52	26	52	30.9	23.3
. . .	30	6	19	12	21.6	6.8
. . .	34	20	17	8	29.6	18.3
. . .	21-39	1-52	5-26	1-52		
. . .	29.73	11.5	17.46	14.66		
. . .		38.6		25.0		

those appearing under three - semantic, on the Tell-a-Story classification, were multiplied by four (as in the visual and auditory modalities classifications); four, labeled "pragmatic" on the Tell-a-Story, was multiplied by 4.5 since it fell between four and five on the visual and auditory modalities. Only one subject out of the 15 scored under "pragmatic" and that score occurred only once.

The multiplied scores were totaled within each classification, that is, visual, auditory, and Tell-a-Story. This was followed by dividing the total of each weighted classification score by the total number of stimuli for that particular classification, by this means arriving at an average score for each subject within each classification (see Table 5). The resultant data were obtained by the calculation of a set of correlation coefficients using the converted scores on the Wepman-Jones and the raw scores on the Seashore Measures (see Table 6).

The analysis of the relationship between the Auditory-Vocal Sequencing Test of the Illinois Test of Pscyholinguistic Abilities and the "pitch," "rhythm," "time," and "tonal memory" subtests of the Seashore Measures utilized the raw scores on each, in the computations of the correlation coefficients. The raw scores and the results of the calculations appear in Table 7.

The summary of the findings, and their interpretation, will be discussed in Chapter IV.

Table 5. Average score for each subject within each classification (visual, auditory, Tell-a-Story) of the Wepman-Jones Language Modalities Test for Aphasia in rank order (R.O.) from least severe to most severe impairment.

Subject	Visual	R.O.	Auditory	R.O.	Tell-a-Story (Free Response)	R.O.
1	1.85	10	1.42	7	2.00	4
2	1.88	11	1.48	9	4.00	8
3	1.07	2	1.09	3	3.00	5
4	1.33	6	1.21	6	3.00	6
5	1.07	3	1.15	5	1.00	1
6	2.70	14	1.48	9	1.00	2
7	1.81	9	1.60	11	4.25	10
8	2.33	13	1.93	12	5.00	11
9	1.11	4	1.12	4	5.00	12
10	1.70	8	2.30	14	5.00	13
11	1.11	4	1.00	1	1.00	3
12	1.00	1	1.00	1	3.00	7
13	3.22	15	2.69	15	5.00	14
14	2.14	12	2.27	13	6.00	15
15	1.62	7	1.42	7	4.00	9
Range	1.00-3.22		1.00-2.69		1.00-6.00	
Mean	1.73		1.54		3.48	

Note: By the method of coding used, the closer to 1.00, the less severe the degree of impairment. Deviations from 1.00 indicate a greater degree of severity of impairment.

Table 6. Correlation coefficients of the six measures of the Seashore with the visual, auditory, and Tell-a-Story classifications of the Wepman-Jones Language Modalities Test.

Seashore Measures	Wepman-Jones Language Modalities Test		
	Visual	Auditory	Tell-a-Story
Pitch	-0.13	-0.33	-0.61
Loudness	-0.01	-0.10	-0.30
Rhythm	+0.22	+0.29	-0.18
Time	+0.05	+0.02	-0.39
Timbre	+0.48	+0.42	+0.31
Tonal Memory	+0.38	+0.30	-0.20

Note: These correlation coefficients were calculated based on the raw scores. The range of the coefficient is from minus one to plus one.

Table 7. Raw scores on the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities, and correlations with the pitch, rhythm, time, and tonal memory subtests of the Seashore Measures.

Subject	Raw Score*
1	22
2	13
3	36
4	21
5	21
6	27
7	17
8	1
9	29
10	18
11	33
12	30
13	2
14	2
15	18

*20 items - two points each for success on first try (total of 40 points)
one point each for success on second try

Range 1 to 36

Mean 19.3

Correlations in rank order with the pitch, rhythm, time, and tonal memory subtests of the Seashore Measures. (from greatest to least magnitude)

With the pitch subtest	+0.397
With the tonal memory subtest	-0.12
With the rhythm subtest	-0.07
With the time subtest	0.00

CHAPTER IV

SUMMARY AND DISCUSSION

Summary

Purpose. The primary purpose of this study was an attempt to determine what indications there were, in a group of aphasic patients, of relationships between the degree of ability to discriminate on the six subtests of the Seashore Measures of Musical Talents and the severity of the aphasic disability, as indicated by results of administering the Wepman-Jones Language Modalities Test.

A secondary purpose was concerned with seeking indications of a relationship between the degree of ability to discriminate on the "pitch," "rhythm," "time," and "tonal memory" subtests of the Seashore Measures and achievement on the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities, in which is involved retention of sound sequences. The retention factor is also implicit in the latter three subtests of the Seashore Measures. The "pitch" subtest relationship was included because pitch appeared to be relatively more impaired in this group of aphasic subjects than any of the other subtests and, therefore, it was thought to warrant further investigation.

Procedure. As previously mentioned in Chapter II, a population of eight male and seven female Caucasian subjects was selected, whose age range was from 39-5 to 64-6 years, with a mean age of 51-6 years. All subjects were medically diagnosed as being aphasic. The results of a pure tone audiometric examination indicated that all subjects fell within the range of hearing required for purposes of this study. Each subject's intellectual level was evaluated by administering the Peabody Picture Vocabulary Test. The mean intelligence quotient for the entire group was 103.8.

The following measures constituted the core of the test procedure: the Wepman-Jones Language Modalities Test, the Seashore Measures of Musical Talents, and the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities. Case history information was procured through an interview with the subject and/or spouse, and through examination of clinical records.

Statistical treatment. The statistical analysis of the data involved the calculation of a set of correlation coefficients to measure linear correlations, as described in Chapter III. Nonparametric statistical methods were also employed to emphasize noteworthy trends that had been observed in the set of correlation coefficients.

Discussion

Results. Prior to discussing the results of this study it is necessary to point out the inverse relationships implicit in the Modalities Test. The higher the score on the Modalities Test (Table 5), the greater the indication of impairment; the lower the score, the less severe the impairment. It is important to note that this inverse relationship may also be seen in Table 6. The higher the negative correlation of the relationship between the scores on the Seashore Measures and those on the Modalities Test, the greater the indications of the observed trends. Although the correlation coefficients were not large, the results manifested the presence of these meaningful trends.

Table 4 summarizes the achievements of the 15 subjects on each of the subtests of the Seashore Measures. These data reveal that the subjects were relatively more impaired on the "pitch" and "loudness" subtests than on any of the other four measures. These results corroborate the findings in the studies by Leutenegger (19) and Saetveit, Lewis, and Seashore (32), whose conclusions point to the "pitch" and "loudness" subtests as measuring properties of sound which are basic to both speech and music. The data in Table 4 also support the conclusions reported by Edmondson, who stated that "Aphasics as a group achieve scores lower on all six Seashore subtests which are considerably lower than could be expected from a random sampling of the normal population." (8)

However, contrary to the findings of Edmondson (8) and

Milner (28), both of whom had noted the most significant change on the "time" subtest, Table 4 reveals the least degree of impairment of discrimination on this subtest in the particular group of subjects who participated in the present study. As attested to by Edmondson, "The 'time' subtest is the only one of the six Seashore tests that distinguished among aphasic subjects according to abilities in language function. . . ." (8) Milner stated that ". . . in the case of Time, the change is significant." (28)

The results incorporated in Tables 4 and 5 form the basis for the correlations in Table 6. Table 5 presents the average score for each subject on each of the classifications of the Modalities Test. Attention is directed to the inverse relationship of scores.

The data in Table 6 disclose the direction of the trends mentioned previously. The linear relationship was calculated with the Tell-a-Story classification, the auditory, and visual modalities ranked in order. The Tell-a-Story relationship was found to be more negative than the auditory and visual in all correlations. The Tell-a-Story classification was consistently more negative than the auditory and, with one exception, the auditory more negative than the visual. Although the absolute precision of the three correlations is lacking in statistical significance, an indicative measure of the relative merits of the three Wepman-Jones classifications can be derived from these data.

In reference to this relative ordering of the three classifications of the Wepman-Jones, the investigator questioned that if this were completely random, what is the probability of this particular combination having arisen by chance? By using the method of binomial probability, it was discovered that this ordering would happen by chance six out of 10,000 times, or 0.00064. It is, therefore, apparent that it would be very unlikely that this sequence of ordering would occur randomly.

The investigator had anticipated that as the response scores on the Seashore increased, indicating achievement closer to normal, the response scores on the Wepman-Jones would decrease, indicative of a lesser degree of impairment. Relative to the visual and auditory classifications, the Tell-a-Story demonstrated a closer correlation with the six subtests of the Seashore Measures; however, these correlations did not reveal statistical significance. A high negative correlation may have been expected if there had been a definite relationship between the Wepman-Jones and the Seashore. Considerable error would probably be inferred by any attempt to state that any one subtest of the Seashore is closely correlated with the subtests of the Wepman-Jones. Rather, the important factor is the arrangement of the coefficients. As previously stated, the "pitch" and "time" subtests correlations express the greatest degree of relationship with the Tell-a-Story classification and further corroborate the conclusions of Leutenegger (19) and Saetveit, Lewis and Seashore (32), despite the subjects having achieved their greatest successes, as a group, on the "time" subtest.

Relative to the correlations of the Seashore subtests with the Wepman-Jones (Table 6), the investigator also asked if there was a probability of these particular correlations having arisen solely by chance. The method of binomial probability disclosed that the chance of any one of the correlations occurring randomly would be one out of approximately 100 times, or 0.0137. Therefore, since it is unlikely that this could have occurred by chance, the Tell-a-Story presents a correlation of greater magnitude, that is, a more negative correlation with the Seashore Measures, than either of the other two classifications, visual and auditory, on the Wepman-Jones.

Table 7 presents the raw scores on the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities and the correlations with the "pitch," "tonal memory," "rhythm," and "time" subtests of the Seashore Measures in rank order. These data indicate little relationship other than the correlation with "pitch" (+0.397), which gives greater evidence of a relationship as compared with -0.12, -0.07, and 0.00 respectively for the other three subtests.

Variables. It is essential to bring into focus certain variables which were present among the population studied. Table 1 presents information on the personal history of each subject, which had been derived from the interview as described in Chapter II, and from the clinical records. Variables that must be taken into consideration are: (1) the range in age--39-5 to 64-6, (2) the time lapse since onset of the trauma--3/4 of a month to 95 months, (3) duration of language retraining--zero to 84 months. It was recognized that there were also variables within the duration of language retraining. Furthermore, the subjects had had varying backgrounds of musical experience, formal education, and pre-morbid occupations. None of these factors can be ruled out as being non-contributory to the results.

Another aspect in evaluating the findings is the size of the population studied. Both Edmondson (8) and Goehl (13) alluded to this aspect in their respective studies. They also took into consideration the variables previously mentioned. The population in the Edmondson study consisted of 22 subjects, ranging in age from 16 to more than 60 years; the lapse of time since onset of trauma varied from three weeks to 10 years; and the subjects' pre-morbid occupations were extremely diversified. The population in the Goehl study included 13 subjects. Both he and Edmondson expressed cognizance of the limitations imposed by small samples and the practical difficulty of obtaining large numbers of subjects, which may possibly limit the extent to which the results can be generalized. The present investigator is also cognizant of these variables and limitations.

Conclusions

The scope of this study encompasses the description and interpretation of the results obtained in the particular population investigated. No assumptions are postulated in regard to a larger population of aphasics. In Chapter I it was stated that considerable emphasis had been placed in the literature on the multiplicity of factors which comprise the aphasic disturbance. In addition, it had been suggested that it appeared practicable to investigate previously explored as well as unexplored avenues, one of which involved the factors of perception and discrimination of sound as they relate to the aphasic disturbance.

The major conclusion afforded by the results of this investigation is that the ability to perceive and discriminate sounds occupies a conspicuous and important role in the aphasic disturbance and should be intensively explored in order to develop new techniques for language retraining. It becomes apparent that the trends disclosed indicate a need for additional inquiry into the areas of perception and discrimination of sound. However, based on the knowledge gained from this study, it is also suggested that future research narrow the criteria in order to evaluate the efficacy of employing capacity for sound perception and discrimination as a diagnostic and prognostic tool, as well as an aid in language retraining for individuals with aphasia.

APPENDICES

APPENDIX A

Model Letter

UNIVERSITY OF FLORIDA
Department of Speech
Gainesville, Florida

____
Date

Dear

This will introduce me as a doctoral candidate in the Department of Speech at the University of Florida. I anticipate the granting of this degree in August, 1965.

All members of my supervisory committee have approved my dissertation prospectus. The subject of the dissertation, "Musical Perception," is concerned with determining: 1. how adults who have language impairments, due to brain damage, perceive musical stimuli; 2. to what extent these abilities are related to communication abilities in the same group.

The procedure will include the administering of: 1. a pure tone audiometric threshold test; 2. the Peabody Picture Vocabulary Test; 3. the Wepman-Jones Language Modalities Test; 4. the Seashore Measures of Musical Talents; 5. the Auditory-Vocal Sequencing Test of the Illinois Test of Psycholinguistic Abilities. It will also be helpful for a member of the patient's family to participate in an interview.

The criteria are: 1. medically diagnosed aphasics--Caucasian, male or female; 2. age range 40 to 65 years;
3. hearing within normal range, at least unilaterally;
4. no more than a moderate degree of dysarthria present.

Should you have patients who meet the above criteria and who would be willing to participate in this research, I would greatly appreciate hearing from you at your earliest convenience. Thank you for any assistance you can provide and I shall look forward to hearing from you.

Most sincerely,

(Miss) Libby Radus

APPENDIX B

CASE HISTORY

Name:

Sex:

Birthdate:

Age:

Marital status:

(Name:
(
Spouse's (Age:
(
(Health:

Occupation (
pre- and (
post- (
morbidly (

(Subject:
Nationality (
(Spouse:
(

Date:

Address:

Phone number:

Physician (s):

Address and phone:

Informant:

Co-informant (if applicable):

Relationship to subject:

Sources of income other than occupation:

How long married?

Age at which married:

First marriage?

Ever separated:

Subject's children

Sex, ages, education, marital status, occupation, number of children:

Others living in household?

Financial status of family (in general); do subject and spouse worry about money? How did he feel about his pre-morbid job? How does he feel about not working now?

Interpersonal adjustments in home (tensions, anxieties, etc.):

Subject's siblings

Sex, ages, education, marital status, present location, occupation:

How did they all get along together?

Does subject see them?

Was there bilingualism in subject's family? Describe:

School and social history

(Subject:
Education (
(Spouse:
(

Verbal output (pre- and post-morbid):
Low: Average: High:

Does he like to be with people, is he outgoing, or does he prefer to be by himself?

Civic club member (pre- and post-morbid):

Church attendance:

Interests and hobbies (pre- and post-morbid):

Musical background (extent of):

1. Listening:
2. Performing:
3. Vocal:
4. Instrumental:

Has he been an independent kind of person? Used to doing things his own way? Wanting others to do things his way?

How do subject and spouse get along (pre- and post-morbidly)?

What are considered to be the main problems presently?

For co-informant only:

How would you describe subject as he is now, compared to the way he was? What does he think about himself, about what has happened to him? What is his attitude toward his illness? How does he react to others' attitudes towards it and him?

How does he handle his feelings?

Interviewer's impressions of subject's self-esteem:

Speech history

Is there anything about the subject's speech developmental history that may have deviated from the norm?

Was a speech defect present before trauma? Describe.

If so, extent of previous training:

Any previous training for present speech/language difficulty?

Present symptoms (as observed by interviewer)

Voice:

Articulation:

Pitch:

Loudness:

Rhythm:

Rate:

Medical history

Vision:

Hearing:

Any present medical disease other than major problem, e.g., chronic heart condition, abnormal EEG, etc.?

Present medical or therapeutic care, on medication or diet:

What kinds of illness had he had pre-morbidly?

How severe is the paralysis?

Is subject ambulatory? If not, explain.

Is he capable of driving a car? Does he?

How does he respond to need for and use of braces?

To what extent can he do things for himself? Take care of his own needs? Make his wants known?

Handedness: Changed since trauma?

Etiology and date:

Remarks

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BIOGRAPHICAL SKETCH

Libby Radus was born in New York City on January 23, 1914. She was graduated from James Madison High School in 1931. She served in the Women's Army Corps from March, 1943 to March, 1946, and was discharged with the rank of captain. For several years she studied voice with Elsie Vecsey and Jane Johnson.

She received her Bachelor of Arts degree in 1950, and the Master of Arts degree in 1951, from the University of Denver. From 1950 to 1951 she also held the post of Supervisor and, from 1951 to 1952, was appointed Assistant to the Director of the Children's Speech Clinic at Denver University.

In 1952 she accepted the position as Director-Speech Pathologist at the Hampton Roads Speech and Hearing Center, Inc., in Newport News, Virginia, where she remained until granted a leave of absence in September, 1963.

Miss Radus is a member of Phi Beta Kappa and Zeta Phi Eta, and a Key and Honor member of Sigma Alpha Eta. She holds the Certificate of Clinical Competence in Speech Pathology in the American Speech and Hearing Association, is a member of the Speech Association of America, and a charter member and Fellow of the Speech and Hearing Association of Virginia.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 14, 1965

Ernest H. Cox
Dean, College of Arts and Sciences

Dean, Graduate School

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